HALEY ALDRICH

www.haleyaldrich.com

EXEMPTION JUSTIFICATION DOCUMENT
IOWA DEPARTMENT OF NATURAL RESOURCES

C6 ZERO –SHINGLE PROCESSING SYSTEM
810 EAST SOUTH STREET
MARENGO, IOWA

WORKING DRAFT

Prepared by Haley & Aldrich, Inc.
Phoenix, Arizona

For Los Alamos Technical Associates, Inc.
Westerville, Ohio

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1. Executive Summary

1.1 INTRODUCTION

C6 Zero operates a shingle processing facility (the Facility) in Marengo, Iowa. The facility uses a patented technology to separate asphalt shingles into their base component pieces for recovery and resale. Emissions from the Facility are primarily volatile organic compounds (VOCs), with a subset of volatile Hazardous Air Pollutions (HAPs) due to evaporation from liquid surfaces in the processing units.

1.2 REGULATORY SUMMARY

Air emission sources are regulated by the Iowa Department of Natural Resources (IDNR) air quality regulations. Pursuant to these regulations, unless covered by an exemption specified in 567 Iowa Administrative Code (IAC) 22.1(2), stationary air pollutant emitting equipment is required to obtain an air construction permit prior to construction or modification. However, there is a Small Unit Exemption promulgated under 567 IAC 22.1(2)(w). Under this exemption, emission units and associated control equipment that emit less than the applicable small unit emission thresholds are not required to obtain a construction permit. For VOCs, the small unit emission threshold is 5 tons per year on a rolling 12-month basis. Facilities claiming a small unit exemption are not required to notify IDNR unless an emission unit exceeds the substantial small unit threshold. For VOCs, this threshold is 3.75 tpy on a rolling 12-month basis. As presented in this document, VOC emissions from the emission units associated with the Facility qualify for the small unit exemption with potential emissions less than the substantial small unit threshold. As such a construction permit and agency notification are not required.

However, facilities claiming a small unit exemption are required to maintain an Exemption Justification Document (EJD) for each emission unit. The EJD must contain emissions estimates and associated operating conditions to demonstrate that the small unit emission thresholds are not exceeded. IDNR has developed a template form for the EJD that can be used by facilities as a model to develop their own exemption justification documents.

1.3 DOCUMENT OVERVIEW

This package provides certified EJD forms for each emission unit (Appendix A) with supplemental information including:

- A description of the emission units with associated air pollution control equipment (Section 2);
- A statement that the emission unit will not be operated without the air pollution control equipment (Section 2);
- A description of how the emissions were determined to be below the annual small unit exemption levels (Section 3);
- A description of production throughputs and operating procedures associated with the emission unit and control equipment to comply with the exemption levels (Section 4); and

- Detailed calculations of emissions reflecting the use of air pollution control devices and throughput limitations (Appendix B).

2. Process Description

The Facility operates a shingle separation process that utilizes a patented technology to separate asphalt shingles into their base component pieces. The process uses a proprietary solvent to dissolve the asphaltenes (long chain hydrocarbons C14 to C20) in the shingles and separate the oil, fiberglass and sand into commercial products. Asphalt shingles include asphaltic (heavy hydrocarbon) compounds that are stable under normal conditions. The proprietary solvent bonds and liquefies the asphaltenes to form new compounds. The chemical bonding (ionic bond) between the solvent and the asphalt shingle produce an oil that can be used as a combustion fuel.

The overall process includes six process steps including:

- Shingle loading
- Shingle processing unit
- Fiberglass processing unit and loader
- Sand polishing
- Oil/Water Separator
- il blending and loading system

Figure 1 (attached) provides the process flow diagram for the overall system. A mass balance for the facility is provided in Appendix B. Each process unit is described in greater detail below.

2.1 SHINGLE LOADING

The shingle loading system includes a loading hopper with conveyor that moves raw shingles through a sorting table for removal of non-recyclable items (i.e., metal and debris) and loads the shingles into the shingle processing unit. Emissions from this unit are considered negligible.

2.2 SHINGLE PROCESSING UNIT

The shingle processing unit is a proprietary component that uses the patented solvent to provide the bulk of the sand, oil, and fiberglass separation. The facility has a single processing unit with a total maximum throughput of 800 tons of shingles per day (tpd). Approximately eighty percent of the asphalt is solubilized and removed as oil, 15% is entrained in the oily sand and 5% is adhered to the fiberglass. The shingles are metered into the shingle processing units with an automated scale ensuring a constant feed rate of shingles. The chemical addition is based on the shingle feed rate to ensure the proper ratio of shingles to chemical. The recovered oil in the shingle processing unit is controlled based on the liquid level in the processing unit. This unit is substantially enclosed with limited openings at either end. The unit is operated at a negative pressure, providing 100% capture of vapors, and exhausted to a carbon unit which provides greater than 85% VOC control.

2.3 FIBERGLASS PROCESSING UNIT AND LOADER

The oily fiberglass exits the shingle processing units and is directly discharged to the fiberglass processing unit. The oily fiberglass enters a trommel or rotary screen and is treated with the propriety solvent which removes the bulk of the residual oil. The liquid discharged from this unit is primarily comprised of the proprietary solvent, which is sent to the first sand screw (see Figure 1). The polished fiberglass is then sent to a rinse water trommel filled with water and a surfactant to remove any residual oil.. The oil/water mix generated from the rinse water trommel is returned to the oil/water separator for oil recovery. The cleaned fiberglass mats are then conveyed to loading supersack for shipment. Similar to the shingle processing unit, the fiberglass processing unit is substantially enclosed with limited openings at either end. The unit is operated at a negative pressure, providing 100% capture of vapors, and exhausted to a carbon unit which provides greater than 85% VOC control.

2.4 SAND POLISHING SYSTEM

The oily sand from the shingle processing unit discharges to a covered screw conveyor that transports the recovered oily sand to the first sand screw. The solvent from the fiberglass processing unit is added for removal of the residual oil from the oily sand. The sand screw conveys the sand to an enclosed shaker table where surfactant is added for final sand polishing. The shaker table discharges to a second screw conveyor for stacking the recovered sand. A surfactant is added to the shaker table for final removal of residual oil.

2.5 OIL/WATER SEPARATORS

There are two oil water separators in the process. The first recovers the oil and water from the fiberglass wash trommel. The recovered oil is pumped to the oil storage tanks and the water returned to the water tank for reuse. The second oil water separator takes the recovered oil and water from the shaker table and deposits the recovered oil to the oil storage with return of the recovered water to a second water tank. This tank also includes the surfactant used in the shaker table for final removal of the oil in the sand.

2.6 OIL BLENDING, STORAGE, AND LOADING SYSTEM

The recovered oil product is pumped to an intermediate tank where it is pumped to a mixing tank where it is blended with B100 at the desired percentage. After mixing, the blended oil is stored in one of four (4) 16,800 gallon oil storage tanks. Maximum production of oil product from the Facility is approximately 55,400 gallons per day.

The oil loading system is used to move oil product from the storage tanks to tanker trucks (or railcars) for resale. This system includes a control system to ensure automatic cutoffs and loading parameters to prevent accidental spillage during loading. Additionally, the loading system will include a containment system to address potential spills. All loading of oil will be inside the building until such time as the outside enclosures are built to protect loading from inclement weather.

3. Emissions Estimates

The section provides potential emissions estimates associated with the proposed asphalt shingle processing system to demonstrate compliance with the small unit exemption thresholds. Emissions from these units are VOCs and HAPs. The HAPs are a subset of the VOC components and therefore are always less than the VOC emissions. As such, for purposes of demonstrating applicability of the small unit exemption, compliance with the VOC thresholds also demonstrates compliance with the HAP thresholds.

3.1 EMISSIONS FROM PROPOSED ASPHALT SHINGLE RECOVERY SYSTEM

As described in Section 2.0, the installation of the proposed asphalt shingle processing system will include the following new emission sources:

- Shingle Processing Unit
- Fiberglass Processing & Final Wash
- Sand Polishing System
- Oil Water Separators (x2)
- Chemical Tanks (x2)
- Oil Storage (x4) mixing tank (1) B100 tanks (2)

Estimated potential emissions from these sources are further described below and summarized in Table 1. Supporting calculations for each emission unit are provided in Appendix B.

3.1.1 Shingle Processing Unit

VOCs are emitted from the liquid surface in the shingle processing unit. The liquid in this unit is comprised of approximately 77% oil product and 23% of proprietary solvent (by weight). Material throughputs, which are provided in Appendix B, are based on the material balance provided by the design engineer for the Facility. Uncontrolled emissions of VOC from this unit were estimated using chemical properties determined through analytical testing, mass balance information and the oil film model from EPA-453/R-94-080A. This unit is designed for 100% capture of the emitted vapor, which will be vented to carbon unit providing at least 85% control.

3.1.2 Fiberglass Processing & Final Wash

VOCs are emitted from the liquid surface in the fiberglass processing unit. The liquid in this unit is comprised of approximately 38% oil product and 62% proprietary solvent (by weight). Material throughputs, which are provided in Appendix B, are based on the material balance provided by the design engineer for the Facility. Uncontrolled emissions of VOC from this unit were estimated using

chemical properties determined through analytical testing, mass balance information and the oil film model from EPA-453/R-94-080A. This unit is designed for 100% capture of the emitted vapor, which will be vented to carbon unit providing at least 85% control.
VOC emissions from the final wash will be significantly less than the fiberglass processing unit because there is significantly less oil product, which is mixed with water. However, in efforts to be conservative, VOC emissions from the fiberglass final wash were estimated assuming the same fractional emissions of oil product as from the fiberglass polish unit.

3.1.3 Sand Polishing System

VOC emissions from the sand polishing system are predominantly associated with sand screw 1 because it has the highest content of oil product and proprietary solvent. For purposes of estimating emissions, this sand screw was divided into two regions: the bottom trough and the top screw. Emissions from the bottom trough were assumed to be driven by liquid evaporation and were estimated using the oil film model from EPA-453/R-94-080A. The liquid in the bottom trough is comprised of approximately 50% oil product and 50% proprietary solvent (by weight). Emission from the top screw portion were assumed to be driven by exposed oily sand and were estimated using the waste application model in EPA-453/R-94-080A. Material throughputs, which are provided in Appendix B, are based on the material balance provided by the design engineer for the Facility.

VOC emissions from the covered shaker table and sand screw 2 will be significantly less than sand screw 1 because there is significantly less oil product, which is mixed with water. However, in efforts to be conservative, VOC emissions from these final sand units were estimated assuming the same fractional emissions of oil product as from sand screw 1.

3.1.4 Oil / Water Separators

VOC emissions from the oil / water separators are based on region 2 of the API Separator model from EPA-453/R-94-080A. Based on the material balance provided by the design engineers, oil/water separator 2 has a higher oil concentration than oil/water separator 1. In efforts to be conservative, emission from both separators were evaluated using the oil concentration of separator 2. The water in oil/water separator 2 has less than 0.1 % oil product.

3.1.5 Chemical Storage Tanks

There are two chemical tanks at the Facility with the potential to emit VOCs. Chemical tank 1 stores virgin proprietary solvent and chemical tank 2 stores recycled proprietary solvent. Emissions from these tanks were estimated using chemical properties determined through analytical testing, throughput information provided by the design engineer and the USEPA methodology for tank emissions as presented in the AP-42 Section 7.1.

3.1.6 Oil Product Storage Tanks

There are four oil product storage tanks at the Facility. Emissions from these tanks were estimated using chemical properties determined through analytical testing, throughput information provided by

the design engineer and the USEPA methodology for tank emissions as presented in the AP-42 Section 7.1. Vapor releases from these tanks will be vented to a carbon unit providing at least 85% control.

3.2 FACILITY POTENTIAL EMISSIONS

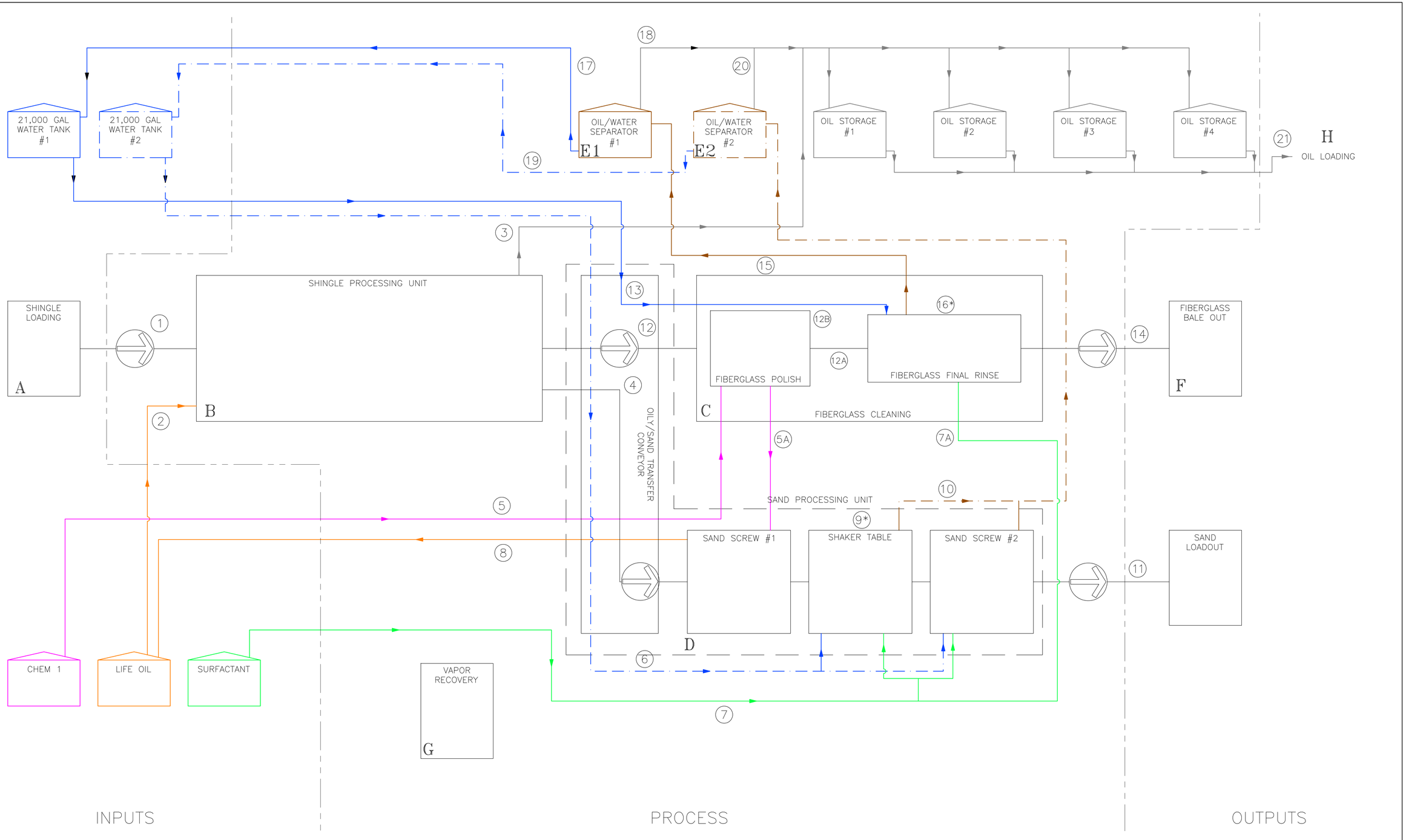
Table 1 provides potential emissions from each emission unit. As presented below, each emission unit has potential emissions less than the small unit exemption thresholds and substantial small unit thresholds.

TABLE 1
C9 ZERO ASPHALT SHINGLE PROCESSING SYSTEM ESTIMATED EMISSIONS

PROCESS UNIT	Assumed Control Efficiency	LBS/YR	TPY
Shingle Processing Unit	85%	7049	3.52
Sand Screw/Shaker Table	0%	4854	2.43
Fiberglass Polish	85%	3480	1.74
Fiberglass Final Wash	0%	38	0.02
OWS#1	0%	68	0.03
OWS#2	0%	68	0.03
Chemical Tank 1	0%	1239	0.62
Lite Oil Tank 2	0%	2371	1.19
Oil Storage #1	0%	609	0.30
Oil Storage #2	85%	609	0.30
Oil Storage #3	85%	609	0.30
Oil Storage #4	85%	609	0.30
TOTAL		21604	10.80

4. Operating Procedures

Figures



NOTES:

1. * EVAPORATOR WATER

REV	DATE	DESCRIPTION	DRAWN BY	DRAFT CHK	PROJ ENGR	LEAD ENGR
0	12/21/17	DRAFT DESIGN				

DATE:
PROFESSIONAL SEAL

Los Alamos Technical Associates, Inc.
756 Park Meadow Road
Westerville, OH 43081
(614) 508-1200 *(Phone)*
www.lata.com

WINSLOW, ARIZONA
ASPHALT SHINGLE RECYCLING PLANT

PROCESS FLOW DIAGRAM

PROJECT NO.: 11418
CADD DWG FILE: J-1 PFD
CLIENT:

J-1
SHEET 1 OF 3

P:\DE BLASI\ASPHALT PROJECT WINSLOW AZ\DRAFTING-GIS\CADD\07-PROCESS\J-1 PFD.DWG

APPENDIX A

EJD Forms

AIR QUALITY BUREAU
502 E 9th St
Des Moines IA 50319

EXEMPTION JUSTIFICATION DOCUMENT TEMPLATE

An owner or operator that utilizes the small unit exemption as specified in 567 IAC 22.1(2)"w" must maintain on-site an exemption justification document. The exemption justification document demonstrates conformance and compliance with the emission rate limits contained in the definition of "small unit" for each emission unit or group of similar emission units that will be covered under the exemption. The minimum information requirements for an exemption justification document are contained in 567 IAC 22.1(2)"w." However, there is no specified format for an exemption justification document. This template is intended to provide an example exemption justification document only and reflects the minimum information that should be included in it.

Facility Name: C6 Zero

Address: 810 East South Street

City: Marengo **State:** IA **Zip Code:** 52301

Emission Point ID: Fiberglass Polishing

Emission Unit(s) Description: Polishes oily fiberglass from the shingle processing unit to remove residual oil.

CONTROL EQUIPMENT (if applicable)

Type: Activated Carbon

Pollutant Controlled: VOC **% Captured:** 100 **% Control Efficiency:** 85

(Note: If control efficiency information is not available from the manufacturer, control efficiencies acceptable to the department can be obtained from the "Iowa Title V Operating Permit Control Efficiency Table" (http://www.iowadnr.gov/Environmental-Protection/Air-Quality/Operating-Permits/Title-V-Technical-Guidance) and EPA's AP-42 Compilation Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources (http://www.epa.gov/ttn/chief/ap42/index.html). If you have questions regarding the appropriate percent capture and control efficiencies to use, please call 1-877-AIR-IOWA)

Initials **Responsible Official: Check the appropriate box(s) below and initials:**

_____ ☒ The emission unit(s) will not be operated without the pollution control device operating.

_____ ☐ A report of the manufacturer's emission testing or other emissions testing was available and is attached to this document.

OPERATIONAL LIMITS

(Specify all operational restrictions that must be maintained to ensure actual emissions remain within the small unit exemption emission limits.)

Hours of Operation: 24 hours/day; 365 days/year **Material Throughput:** ~27.7 tons/day of oily fiberglass

Other: Produces ~15 tons per day of fiberglass product.

NARRATIVE

Provide a narrative description of how the emissions from the emission unit or group of similar emission units were determined and maintained at or below the annual small unit exemption levels:

See Sections 2 and 3 of Supporting Document.

CALCULATIONS

Provide detailed emission calculations reflecting control devices and operational limits specified above. The resulting emission rates establish a limit on the potential emissions from that emission unit or group of similar emission units. (Note: Calculations must reflect both the controlled and uncontrolled emissions. For example, an emissions unit with a capture hood that is 80% efficient and a baghouse that is 95% efficient will have an emission rate that is the sum of the 95% control on 80% of the emissions from the baghouse stack and the remaining 20% of the emissions not captured by the hood. If you have questions regarding the emission calculations, please call 1-877-AIR-IOWA.)

See Section 3 and Appendix B of Supporting Document. Annual emissions are estimated at 1.74 tons per year of VOC.

☐ **This emission unit(s) qualifies as a "substantial small unit" as defined in 567 IAC 22.1(2)"w"(6).**

☒ **The cumulative emissions for all "substantial small units" has been reviewed to ensure that the cumulative notice threshold defined in 567 IAC 22.1(2)"w"(8) has not been exceeded.** (See cumulative emissions summary sheet attachment.)

Note: DNR must be notified in writing 10 days prior to commencing construction of any new or modified substantial small unit and within 30 days after determining that an existing small unit meets the criteria for a substantial small unit. Additionally, DNR must be notified within 90 days of the end of the calendar year for which the aggregate emissions from substantial small units have reached any of the cumulative notice thresholds.

Specify records of actual operation that will be used as objective evidence that the actual annual emissions are maintained under the small unit exemption levels. All records demonstrating compliance with each exemption justification document shall be maintained for five years. Records shall include 12-month rolling totals where appropriate.

The facility will record monthly the total amount of shingles processed at the facility and use the attached calculations to estimate actual emissions. The facility will maintain records of maintenance and carbon replacement on the control equipment.

STATEMENT OF CERTIFICATION OF COMPLIANCE

"I certify that the information contained in this document accurately reflects the actual operating conditions and that the emission unit(s) included in this exemption status will continue to operate under the small unit exemption thresholds as specified in 567 IAC 22.1(2) "w"(1). I also understand that this exemption justification document must be made available for review during normal business hours and for state or EPA on-site inspections, and shall be provided to the Director of the Department of Natural Resources or the Director's representative upon request."

	President
Signature of Responsible Official	Title of Responsible Official
Howard Brand	
Printed Name of Responsible Official	Date Signed

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See Sections 2 and 3 of Supporting Document.

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Provide detailed emission calculations reflecting control devices and operational limits specified above. The resulting emission rates establish a limit on the potential emissions from that emission unit or group of similar emission units. (Note: Calculations must reflect both the controlled and uncontrolled emissions. For example, an emissions unit with a capture hood that is 80% efficient and a baghouse that is 95% efficient will have an emission rate that is the sum of the 95% control on 80% of the emissions from the baghouse stack and the remaining 20% of the emissions not captured by the hood. If you have questions regarding the emission calculations, please call 1-877-AIR-IOWA.)

See Section 3 and Appendix B of Supporting Document. Annual emissions are estimated at 1.74 tons per year of VOC.

☐ **This emission unit(s) qualifies as a "substantial small unit" as defined in 567 IAC 22.1(2)"w"(6).**

☒ **The cumulative emissions for all "substantial small units" has been reviewed to ensure that the cumulative notice threshold defined in 567 IAC 22.1(2)"w"(8) has not been exceeded.** (See cumulative emissions summary sheet attachment.)

Note: DNR must be notified in writing 10 days prior to commencing construction of any new or modified substantial small unit and within 30 days after determining that an existing small unit meets the criteria for a substantial small unit. Additionally, DNR must be notified within 90 days of the end of the calendar year for which the aggregate emissions from substantial small units have reached any of the cumulative notice thresholds.

Specify records of actual operation that will be used as objective evidence that the actual annual emissions are maintained under the small unit exemption levels. All records demonstrating compliance with each exemption justification document shall be maintained for five years. Records shall include 12-month rolling totals where appropriate.

The facility will record monthly the total amount of shingles processed at the facility and use the attached calculations to estimate actual emissions. The facility will maintain records of maintenance and carbon replacement on the control equipment.

STATEMENT OF CERTIFICATION OF COMPLIANCE

"I certify that the information contained in this document accurately reflects the actual operating conditions and that the emission unit(s) included in this exemption status will continue to operate under the small unit exemption thresholds as specified in 567 IAC 22.1(2) "w"(1). I also understand that this exemption justification document must be made available for review during normal business hours and for state or EPA on-site inspections, and shall be provided to the Director of the Department of Natural Resources or the Director's representative upon request."

	President
Signature of Responsible Official	Title of Responsible Official
Howard Brand	
Printed Name of Responsible Official	Date Signed

AIR QUALITY BUREAU
502 E 9th St
Des Moines IA 50319

EXEMPTION JUSTIFICATION DOCUMENT TEMPLATE

An owner or operator that utilizes the small unit exemption as specified in 567 IAC 22.1(2)"w" must maintain on-site an exemption justification document. The exemption justification document demonstrates conformance and compliance with the emission rate limits contained in the definition of "small unit" for each emission unit or group of similar emission units that will be covered under the exemption. The minimum information requirements for an exemption justification document are contained in 567 IAC 22.1(2)"w." However, there is no specified format for an exemption justification document. This template is intended to provide an example exemption justification document only and reflects the minimum information that should be included in it.

Facility Name: C6 Zero

Address: 810 East South Street

City: Marengo **State:** IA **Zip Code:** 52301

Emission Point ID: Fiberglass Polishing

Emission Unit(s) Description: Polishes oily fiberglass from the shingle processing unit to remove residual oil.

CONTROL EQUIPMENT (if applicable)

Type: Activated Carbon

Pollutant Controlled: VOC **% Captured:** 100 **% Control Efficiency:** 85

(Note: If control efficiency information is not available from the manufacturer, control efficiencies acceptable to the department can be obtained from the "Iowa Title V Operating Permit Control Efficiency Table" (http://www.iowadnr.gov/Environmental-Protection/Air-Quality/Operating-Permits/Title-V-Technical-Guidance) and EPA's AP-42 Compilation Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources (http://www.epa.gov/ttn/chief/ap42/index.html). If you have questions regarding the appropriate percent capture and control efficiencies to use, please call 1-877-AIR-IOWA)

Initials **Responsible Official: Check the appropriate box(s) below and initials:**

_____ ☒ The emission unit(s) will not be operated without the pollution control device operating.

_____ ☐ A report of the manufacturer's emission testing or other emissions testing was available and is attached to this document.

OPERATIONAL LIMITS

(Specify all operational restrictions that must be maintained to ensure actual emissions remain within the small unit exemption emission limits.)

Hours of Operation: 24 hours/day; 365 days/year **Material Throughput:** ~27.7 tons/day of oily fiberglass

Other: Produces ~15 tons per day of fiberglass product.

NARRATIVE

Provide a narrative description of how the emissions from the emission unit or group of similar emission units were determined and maintained at or below the annual small unit exemption levels:

See Sections 2 and 3 of Supporting Document.

CALCULATIONS

Provide detailed emission calculations reflecting control devices and operational limits specified above. The resulting emission rates establish a limit on the potential emissions from that emission unit or group of similar emission units. (Note: Calculations must reflect both the controlled and uncontrolled emissions. For example, an emissions unit with a capture hood that is 80% efficient and a baghouse that is 95% efficient will have an emission rate that is the sum of the 95% control on 80% of the emissions from the baghouse stack and the remaining 20% of the emissions not captured by the hood. If you have questions regarding the emission calculations, please call 1-877-AIR-IOWA.)

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CONTROL EQUIPMENT (if applicable)

Type: Activated Carbon

Pollutant Controlled: VOC **% Captured:** 100 **% Control Efficiency:** 85

(Note: If control efficiency information is not available from the manufacturer, control efficiencies acceptable to the department can be obtained from the "Iowa Title V Operating Permit Control Efficiency Table" (http://www.iowadnr.gov/Environmental-Protection/Air-Quality/Operating-Permits/Title-V-Technical-Guidance) and EPA's AP-42 Compilation Air Pollutant Emission Factors, Volume I, Stationary Point and Area Sources (http://www.epa.gov/ttn/chief/ap42/index.html). If you have questions regarding the appropriate percent capture and control efficiencies to use, please call 1-877-AIR-IOWA)

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	President
Signature of Responsible Official	Title of Responsible Official
Howard Brand	
Printed Name of Responsible Official	Date Signed

APPENDIX B

Supporting Calculations

Emissions Summary - Asphalt Shingle Recycling

PROCESS UNIT	Emission Rates (lb/yr)				
	Uncontrolled VOC		Overall Control Efficiency (%)	Controlled VOC	
	lb/yr	tpy		lb/yr	tpy
Shingle Processing Unit	46995	23.50	85%	7049	3.52
Sand Screw/Shaker Table	4854	2.43	0%	4854	2.43
Fiberglass Polish	23200	11.60	85%	3480	1.74
Fiberglass Final Wash	38	0.02	0%	38	0.02
OWS#1	68	0.03	0%	68	0.03
OWS#2	68	0.03	0%	68	0.03
Chemical Tank 1	1239	0.62	0%	1239	0.62
Lite Oil Tank 2[/A]	2371	1.19	0%	2371	1.19
Oil Storage #1[/B]	4059	2.03	85%	609	0.30
Oil Storage #2[/B]	4059	2.03	85%	609	0.30
Oil Storage #3[/B]	4059	2.03	85%	609	0.30
Oil Storage #4[/B]	4059	2.03	85%	609	0.30
TOTAL (lb/yr)	95069	47.5		21604	10.80

A Chemical tank emissions calculated in Tank Emissions Spreadsheet for Chemical Tanks and Lite Oil Tank assumed to have the same chemical properities as the C6Zero Virgin Chemical

B Emissions calculated in Tank Emissions Spreadsheet for Oil Storage Tanks

Chemical Properties

C6 Zero Chemical

Component	% by wght	Est. MW	Basis
Isoparaffins (C5 – C7)	34.1	86	MW based on hexane (C6)
Paraffins (C5 – C7)	28.9	86	MW based on hexane (C6)
N,N- dimethylstearamide	22.7	311.5	
Alkylated naphthalene	10.6	128	MW based on naphthalene
Naphthenics (C5 – C7)	2.6	84	MW based on cyclohexane (C6)
Olefins (C5 – C7)	0.7	84	MW based on hexene (C6)
2-propanol	0.2	60	
Indene	0.1	116.16	
Low level and unidentified compounds	0.1	not included	
Average MW		**141.5**	
Density		**0.7286**	s.g.
Density		**6.076524**	lb/gal
Vapor Pressure		**39**	mmHg

C6 Zero Production Fuel

Estimated MW		**170**	based on MW of Kerosene
Density		**0.822**	s.g.
Density		**6.85548**	lb/gal
Vapor Pressure		**35**	mmHg

Table 1. Asphalt Shingle Processing Unit Process Evaluation Summary Iowa Plant

source: mass balance asphalt Shingle system process iowa tjs 7 15 21.xlxs

Inputs									Outputs							
Description	chemical (gal)	chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)	PROCESS	Description	chemical (gal)	Chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)
1. Shingles	-	-	-	67,200	469,421	1,080,000	30,000	Shingle Processing Unit	3. Recovered oil	-	-	-	55,373	491,568	-	-
2. Lite oil from Tank#2	-	-	-	17,952	123,371	-	-		4. Oily sand	-	-	-	10,080	75,919	1,080,000	-
									12. Oily fiberglass	-	-	-	3,360	25,306	-	30,000
4. Oily Sand	-	-	-	10,080	75,919	1,080,000	-	Sand Screw/Shaker Table	8. light Return to tank#2	-	-	-	17,952	123,371	-	-
5a lite oil to sand screw	-	-	-	8,266	53,946	-	-		9. Water and surfatant Evaporation	43	390	8,640	-	-	-	-
6. Water	-	-	432,000	-	-	-	-		10. Oily Water to OWS#2	-	-	423,360	567	3,896	-	-
7. surfactant	43	390		-	-	-	-		11. Sand	-	-	-	378	2,597	1,080,000	-
8. light Return to tank#2	0	0	0	17952	123371	0	0	Lite oil tank#2	2. lite oil to Shingle process	-	-	-	17,952	123,371	-	-
12.Oily Fiberglass	-	-	-	3,360	25,306	-	30,000	Fiberglass polish	12a. Fiberglass	-	-	-	84	549	-	30,000
5. Chem#1	4,800	35,616	-	-	-	-	-		5a lite oil to sand screw	-	-	-	8,266	53,946	-	-
									12B. Chem#1 evaporation	-	356	-	-	-	-	-
12a cleaner fiberglass	-	-	-	84	549	-	30,000	Fiberglass final wash	15. Oily water to OWS#1	-	-	423,360	84	549	-	-
13. Water	-	-	432,000	-	-	-	-		14. final Clean Fiberglass	-	-	-	-	-	-	30,000
7a. surfactant	86	779	-	-	-	-	-		16 water/surfactant evapor	-	86	8,640	-	-	-	-
10. Oily Water	-	-	423,360	84	549	-	-	OWS#1	17. Water Return	-	-	423,360	-	-	-	-
									18. Recovered Oil	-	-	-	84	549	-	-
15. Oily Water	-	-	423,360	567	3,896	-	-	OWS#2	19. Water Return	-	-	423,360	-	-	-	-
									20. Recovered Oil	-	-	-	567	3,896	-	-
Total inputs	**4,930**	**36,785**	**1,710,720**	**125,545**	**876,327**	**2,160,000**	**90,000**		**Total outputs**		832	1,710,720	114,746	905,515	2,160,000	90,000
									Total inputs		36,785	1,710,720	125,545	876,327	2,160,000	90,000
									Net Difference		(35,953)	-	(10,798)	29,188	-	-

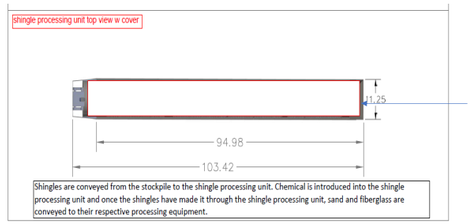
Notes:

Process based on 24-hour operation and individual assumptions for each process unit

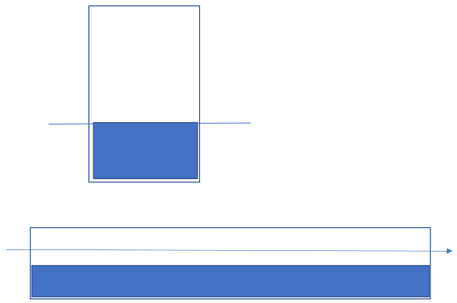
Quantities are after the system is in operation and do not include the initial filling of the process units

Shingle Processing Unit

Inputs									Outputs							
Description	chemical (gal)	chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)	PROCESS	Description	chemical (gal)	Chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)
1. Shingles	-	-	-	67,200	469,421	1,080,000	30,000	Shingle Processing Unit	3. Recovered oil	-	-	-	55,373	491,568	-	-
2. Lite oil from Tank#2	-	-	-	17,952	123,371	-	-		4. Oily sand	-	-	-	10,080	75,919	1,080,000	-
									12. Oily fiberglass	-	-	-	3,360	25,306	-	30,000



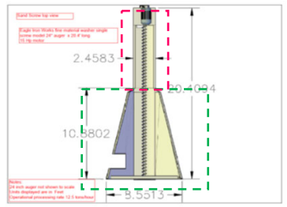
Process Information		Oily Product	Lite Oil	Benzene	Ethylbenzene	Naphthalene	Toluene
Flowrate of Product (total both units)	gal/day	67,200	17,952				
Density of liquid	lb/gal	6.076524	6.85548				
Specific Gravity of liquid	g/cm3	0.73	0.82				
Flowrate of Product (total both units)	lb/day	408342.4128	123067.7561				
Concentration of constituent in liquid	wght %	76.841	23.159				
chemical properties							
molecular weight	g/gmol	170.00	141.47	78.1	106.2	128.2	92.4
vapor pressure (@ 25C)	mmHg	35	39	95.2	10	0.23	30
est. diffusivity in air	cm2/sec	0.04	0.04	0.088	0.075	0.059	0.087
Process Equipment Specs							
length of processing unit	ft	94.98	94.98	94.98	94.98	94.98	94.98
width of processing unit	ft	11.25	11.25	120	120	120	120
surface area of processing unit	ft2	1068.5	1068.5	1068.5	1068.5	1068.5	1068.5
equivalent D of proc unit	ft	36.88	36.88	36.88	36.88	36.88	36.88
diameter of trommel drum	ft	10	10				
cross sectional area of inlet opening	ft2	55.180	55.180				
cross sectional area of outlet openings	ft2	20.500	20.500				
cross sectional area of processing unit	ft2	123.750	123.750				
level of liquid in processing unit	ft	4	4				
open cross section area in process unit	ft2	78.75	78.75				
assumed face velocity at openings	ft/min	200	200				
flowrate through processing unit	ft3/min	12167.1	12167.1				
velocity of air over liquid	ft/min	154.5	154.5				
constants							
viscosity of air	g/cm s	1.81E-04	1.81E-04	1.81E-04	1.81E-04	1.81E-04	1.81E-04
density of air	g/cm3	1.20E-03	1.20E-03	1.20E-03	1.20E-03	1.20E-03	1.20E-03
universal gas constant	atm cm3/gmol	82.06	82.06	82.06	82.06	82.06	82.06
molecular weight of air	g/gmol	29	29				
calculation of mass transfer coefficient		**Kg = 4.82 * 0.001 * U^0.78 * SCg^-0.67 * de ^ 0.11**					
average windspeed (U)	m/s	0.784877475	0.784877475	0.784877475	0.784877475	0.784877475	0.784877475
effective diameter of surface area (de)	m	11.24	11.24	#REF!	#REF!	#REF!	#REF!
density of air (pa)	g/cm3	1.20E-03	1.20E-03	1.20E-03	1.20E-03	1.20E-03	1.20E-03
viscosity of air (ua)	g/cm s	1.81E-04	1.81E-04	1.81E-04	1.81E-04	1.81E-04	1.81E-04
diffusivity in air (Da)	cm2/sec	4.00E-02	4.00E-02	1.29E-02	1.10E-02	8.63E-03	1.27E-02
Schmidt number (SCg = ua / (pa * Da))	-	3.77	3.77	11.72	13.75	17.47	11.85
mass transfer coefficient (Kg)	cm/s	2.14E-03	2.14E-03	#REF!	#REF!	#REF!	#REF!
calculation of equilibrium partitioning coefficient		**Keq = (Pi * pair * MWoil) / (Pt * poil * MWair)**					
molecular weight of oil prod (MWoil)	g/gmol	170	170	0	0	0	0
molecular weight of constituent (MWi)	g/gmol	170	141.46666	78.1	106.2	128.2	92.4
concentration of oil prod (Coil)	g/kg	1000	1000	0	0	0	0
concentration of constituent (Ci)	g/kg	768.4128695	231.5871305	0	0	0	0
concentration of constitutent in oil prod (Ci	g/cm3	0.559865617	0.190364621				
vapor pressure of constituent (Pi) @ T	atm	0.046052632	0.051315789	0.125263158	0.013157895	0.000302632	0.039473684
total pressure (Pt)	atm	1	1				
temperature (T)	C	25	25	25	25	25	25
temperature (T)	K	298	298	298	298	298	298
Equilibrium Partitioning Coeff.	Keq	4.45E-04	3.65E-04				
calculation of emissions		**E = Kg * Keq * A * Ci**					
concentration in oil product (Ci)	g/cm3	5.60E-01	1.90E-01	#REF!	#REF!	#REF!	#REF!
mass transfer coefficient (Kg)	cm/s	2.14E-03	2.14E-03	#REF!	#REF!	#REF!	#REF!
Equilibrium Partitioning Coeff. (Keq)	Keq	4.45E-04	3.65E-04				
surface area of processing unit (A)	cm2	992692.2	992692.2	#REF!	#REF!	#REF!	#REF!
emissions	g/s	0.53	0.15	#REF!	#REF!	#REF!	#REF!
emissions	lb/hr	4.193	1.172	#REF!	#REF!	#REF!	#REF!
emissions	lb/day	100.63	28.12	#REF!	#REF!	#REF!	#REF!
emissions	lb/yr	36730.0	10264.6	#REF!	#REF!	#REF!	#REF!
calculation of % emitted							
liquid constituent throughput	lb/day	408342.4128	123067.7561	0	0	0	0
amount of constituent emitted	lb/day	100.6	28.1	#REF!	#REF!	#REF!	#REF!
% emitted	%	0.02464%	0.02285%	#REF!	#REF!	#REF!	#REF!

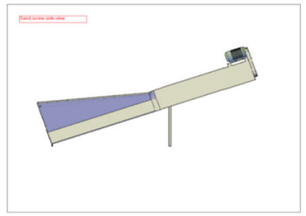


notes:
trommel drum rotates at 1 revolution/min such that the surface of the liquid inside the drum is quiescent
Used the oil film model from EPA-453/R-94-080A
assume that the lite oil fed to the shingle processing has the same chemical properties as the C6Zero proprietary chemical

Sand Screw_Shaker Emissions

Description	chemical (gal)	chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)	PROCESS	Description	chemical (gal)	Chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)
4. Oily Sand	-	-	-	10,080	75,919	1,080,000	-	Sand Screw/Shaker Table	8. light Return to tank#2	-	-	-	17,952	123,371	-	-
5a lite oil to sand screw	-	-	-	8,266	53,946	-	-		9. Water and surfatant Evaporation	43	390	8,640	-	-	-	-
6. Water	-	-	432,000	-	-	-	-		10. Oily Water to OWS#2	-	-	423,360	567	3,896	-	-
7. surfactant	43	390		-	-	-	-		11. Sand	-	-	-	378	2,597	1,080,000	-





		Bottom Trough of Sand Screw 1		Top of Sand Screw 1	Shaker Table and Sand Screw 2
Process Information		**Oil Product**	**Light Oil from fiberglass polish**	**Lite Oil return**	**Oil Product**
Flowrate of free liquid	gal/day	9,686	8,266	17,952	945
Density of liquid	lb/gal	**6.076524**	**6.85548**	7.16	7.16
Specific Gravity of liquid	g/cm3	0.73	0.82	0.86	0.86
Flowrate of Oils in sand screw	lb/day	58854.52072	56668.61253	128534.4	6765.0
Concentration of constituent in liquid	wght %	50.946	49.054	100.000	
chemical properties					
molecular weight	g/gmol	**170.00**	**141.47**	150	
vapor pressure (@ 25C)	mmHg	**35.00**	**39.00**	7	
est. diffusivity in air	cm2/sec	**0.04**	**0.04**	0.04	
Equipment Dimensions					
length of bottom trough	***ft***	***10.8802***	***10.8802***	***9.5292***	
width of bottom trough	***ft***	***8.5513***	***8.5513***	***2.4583***	
surface of bottom trough	***ft2***	***93.0398543***	***93.03985426***	***23.42563236***	
equivalent D of trough	***ft***	***10.884026***	***10.88402599***	***5.461358941***	
constants					
viscosity of air	g/cm s	1.81E-04	1.81E-04	1.81E-04	
density of air	g/cm3	1.20E-03	1.20E-03	1.20E-03	
universal gas constant	atm cm3/gmol K	82.06	82.06	82.06	
molecular weight of air	g/gmol	29	29	29	
calculation of mass transfer coefficient		**Kg = 4.82 * 0.001 * U^0.78 * SCg^-0.67 * de ^ 0.11**		**Kg = 9.64 * 0.001 * U^0.78 * SCg^-0.67 * de ^ 0.11**	
average windspeed (U)	m/s	1	1	1	
effective diameter of surface area (de)	m	3.32	3.32	1.66	
density of air (pa)	g/cm3	1.20E-03	1.20E-03	1.20E-03	
viscosity of air (ua)	g/cm s	1.81E-04	1.81E-04	1.81E-04	
diffusivity in air (Da)	cm2/sec	4.00E-02	4.00E-02	4.00E-02	
Schmidt number (SCg = ua / (pa * Da))	-	3.77	3.77	3.77	
mass transfer coefficient (Kg)	cm/s	2.26E-03	2.26E-03	4.19E-03	
calculation of equilibrium partitioning coef		**Keq = (Pi * pair * MWoil) / (Pt * poil * MWair)**		**Keq = Cg/Cl**	
molecular weight of oil prod (MWoil)	g/gmol	170	141.46666	150	
molecular weight of constituent (MWi)	g/gmol	170	141.46666	150	
concentration of oil prod (Coil)	g/kg	1000	1000	1000	
concentration of constituent (Ci)	g/kg	509.4609111	490.5390889	1000	
concentration of constitutent in oil prod (Cg	g/cm3	0.37119322	0.403223131	0.858513189	
vapor pressure of constituent (Pi) @ T	atm	0.046052632	0.051315789	0.009210526	
total pressure (Pt)	atm	1	1	1	
Universal gas constant (R)	atm cm3/mol K	82.0575	82.0575	82.0575	
temperature (T)	C	25	25	25	
temperature (T)	K	298	298	298	
concentration of constituent in gas (Cg)	g/cm3			5.64991E-05	
Equilibrium Partitioning Coeff.	Keq	4.45E-04	3.65E-04	6.58E-05	
calculation of emissions		**E = Kg * Keq * A * Ci**			
concentration in oil product (Ci)	g/cm3	3.71E-01	4.03E-01	8.59E-01	
mass transfer coefficient (Kg)	cm/s	2.26E-03	2.26E-03	4.19E-03	
Equilibrium Partitioning Coeff.	Keq	4.45E-04	3.65E-04	6.58E-05	
surface area of processing unit	cm2	86436.9	86436.9	21763.1	
emissions	g/s	0.0322	0.0288	0.0052	0.222360
emissions	lb/hr	0.256	0.228	0.041	0.029387
emissions	lb/day	6.14	5.48	0.98	0.705282
emissions	lb/yr	2239.6	1999.6	357.9	257.427962
calculation of % emitted					
liquid constituent throughput	lb/day	58854.52072	56668.61253	128534.4183	6764.969384
amount of constituent emitted	lb/day	6.14	5.5	0.98	0.705
% emitted	%	0.01043%	0.00967%	0.00076%	0.010426%

The % emitted from the Shaker Table and Sand Screw 2 will be less than the fractional emissions from the liquid surface at the bottom of sand screw 1 because there is significantly less oil product and it is mixed with water. In efforts to be conservative, the combined emissions from the shaker table and sand screw 2 were estimated assuming the same fractional emissions as from the liquid surface in sand screw 1.

notes:
calculations for bottom trough based on the oil film model EPA document: Air Emissions Models for Waste and wastewater (EPA-453/R-94-080A)
calculations for top screw portion based on the waste application model in EPA document Air Emissions Models for Waste and Wastewater (EPA-453/R-94-080A)
assume the lite oil from fiberglass polish has the same properties as C6Zero Chemical
assume the lite oil returned to the tank has the same vapor pressure and molecular weight as the C6Zero Chemical

Fiberglass Polishing and Final Wash

Inputs									Outputs							
Description	chemical (gal)	chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)	PROCESS	Description	chemical (gal)	Chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)
12.Oily Fiberglass	-	-	-	3,360	25,306	-	30,000	Fiberglass polish	12a. Fiberglass	-	-	-	84	549	-	30,000
5. Chem#1	4,800	35,616	-	-	-	-	-		5a lite oil to sand screw	-	-	-	8,266	53,946	-	-
	-	-	-	-	-	-	-		12B. Chem#1 evaporation	-	356	-	-	-	-	-
12a cleaner fiberglass	-	-	-	84	549	-	30,000	Fiberglass final wash	15. Oily water to OWS#1	-	-	423,360	84	549	-	-
13. Water	-	-	432,000	-	-	-	-		14. final Clean Fiberglass	-	-	-	-	-	-	30,000
7a. surfactant	86	779	-	-	-	-	-		16 water/surfactant evaporation	-	86	8,640	-	-	-	-
						55,306										
						27.65	15									

Process Information		Oil Product	C6 Zero Chemical	Shaker Table and Sand Screw 2 Oil Product
Flowrate of Product (total both units)	gal/day	3,360	4,800	84
Density of liquid	lb/gal	6.076524	6.85548	7.16
Specific Gravity of liquid	g/cm3	0.73	0.82	0.86
Flowrate of Product (total both units)	lb/day	20417.12064	32906.304	601.78
Concentration of constituent in liquid	wght %	38.289	61.711	
chemical properties				
molecular weight	g/gmol	170.00	141.47	
vapor pressure (@ 25C)	mmHg	35.00	39.00	
est. diffusivity in air	cm2/sec	0.04	0.04	
Process Equipment Specs				
length of processing unit	ft	50	50	
width of processing unit	ft	11.25	11.25	
surface area of processing unit	ft2	562.5	562.5	
equivalent D of proc unit	ft	26.76186174	26.76186174	
constants				
viscosity of air	g/cm s	1.81E-04	1.81E-04	
density of air	g/cm3	1.20E-03	1.20E-03	
universal gas constant	atm cm3/gmc	82.06	82.06	
molecular weight of air	g/gmol	29	29	
calculation of mass transfer coefficient		**Kg = 4.82 * 0.001 * U^0.78 * SCg^-0.67 * de ^ 0.11**		
average windspeed (U)	m/s	0.784877475	0.784877475	
effective diameter of surface area (de)	m	8.16	8.16	
density of air (pa)	g/cm3	1.20E-03	1.20E-03	
viscosity of air (ua)	g/cm s	1.81E-04	1.81E-04	
diffusivity in air (Da)	cm2/sec	4.00E-02	4.00E-02	
Schmidt number (SCg = ua / (pa * Da))	-	3.77	3.77	
mass transfer coefficient (Kg)	cm/s	2.07E-03	2.07E-03	
calculation of equilibrium partitioning coefficient			**Keq = (Pi * pair * MWoil) / (Pt * poil * MWair)**	
molecular weight of oil prod (MWoil)	g/gmol	170	170	
molecular weight of constituent (MWi)	g/gmol	170	141.46666	
concentration of oil prod (Coil)	g/kg	1000	1000	
concentration of constituent (Ci)	g/kg	382.8921488	617.1078512	
concentration of constitutent in oil prod	g/cm3	0.27897522	0.507262654	
vapor pressure of constituent (Pi) @ T	atm	0.046052632	0.051315789	
total pressure (Pt)	atm	1	1	
temperature (T)	C	25	25	
temperature (T)	K	298	298	
Equilibrium Partitioning Coeff.	Keq	4.45E-04	3.65E-04	
calculation of emissions		**E = Kg * Keq * A * Ci**		
concentration in oil product (Ci)	g/cm3	2.79E-01	5.07E-01	
mass transfer coefficient (Kg)	cm/s	2.07E-03	2.07E-03	
Equilibrium Partitioning Coeff.	Keq	4.45E-04	3.65E-04	
surface area of processing unit	cm2	522579.6	522579.6	
emissions	g/s	0.1339	0.20	0.033071
emissions	lb/hr	1.062	1.587	0.004371
emissions	lb/day	25.48	38.08	0.104895
emissions	lb/yr	9300.7	13899.5	38.286626
calculation of % emitted				
liquid constituent throughput	lb/day	20417.12064	32906.304	84.048
amount of constituent emitted	lb/day	25.5	38.1	0.104895
% emitted	%	0.12480%	0.11573%	0.124804%

The % emitted from the fiberglass final wash will be less than the fractional emissions from the fiberglass polish because there is significantly less oil product and it is mixed with water. In efforts to be conservative, the emissions from the fiberglass final wash were estimated assuming the same fractional emissions of oil product as from the fiberglass polish unit

notes:
trommel drum rotates at 1 revolution/min such that the surface of the liquid inside the drum is quiescent
Used the oil film model from EPA-453/R-94-080A
assume 1 m/s as a conservative estimate of air flow over the liquid surface of a covered process unit

Sand Screw_Shaker Emissions

Description	chemical (gal)	chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)	PROCESS	chemical (gal)	Chemical (lbs)	water (gal)	oil (gal)	oil (lbs)	sand (lbs)	fiberglass (lbs)
10. Oily Water	-	-	423,360	84	549	-	-	OWS#1	-	-	423,360	-	-	-	-
	-	-	-	-	-	-	-		-	-	-	84	549	-	-
15. Oily Water	-	-	423,360	567	3,896	-	-	OWS#2	-	-	423,360	-	-	-	-
	-	-	-	-	-	-	-		-	-	-	567	3,896	-	-

Oil Water Separator

Process Information		Oil Product	Water
Flowrate of free liquid	gal/day	567	423,360
Density of liquid	lb/gal	6.076524	8.34
Specific Gravity of liquid	g/cm3	0.73	1.00
Flowrate of Oils in sand screw	lb/day	3444.8	3530822.4
Concentration of constituent in liquid	wght %	0.00097	
chemical properties			
molecular weight	g/gmol	170.00	
vapor pressure (@ 25C)	mmHg	35.00	
est. diffusivity in air	cm2/sec	0.04	
tank dimensions			
length of frac tank	*ft*	*46.25*	
width of frac tank	*ft*	*8.5*	
surface area in tank	*ft2*	*393.125*	
Equivalent D of Tank	*ft*	*22.4*	
constants			
viscosity of air	g/cm s	1.81E-04	
density of air	g/cm3	1.20E-03	
universal gas constant	atm cm3/gmol K	82.06	
molecular weight of air	g/gmol	29	
calculation of mass transfer coefficient		**Kg = 0.00482 *(U/100)^0.78 *(De/100)^-0.11 * (0.0012 * Da/0.000181)^0.67**	
average windspeed (U)	cm/s	100	
effective diameter of surface area (de)	cm	681.92	
density of air (pa)	g/cm3	1.20E-03	
viscosity of air (ua)	g/cm s	1.81E-04	
diffusivity in air (Da)	cm2/sec	4.00E-02	
Schmidt number (SCg = ua / (pa * Da))	-	3.77	
mass transfer coefficient (Kg)	cm/s	1.60E-03	
calculation of equilibrium partitioning coef		**Keq = (0.0012 * Vp * MW) / (p * 28.8 * 760)**	
molecular weight of constituent	g/gmol	170	
vapor pressure of constituent (Pi) @ T	mmHg	35	
density of constituent (p)	g/cm3	0.73	
concentration of constituent (Ci)	g/kg	0.009746752	
concentration of constitutent in oil prod (C	g/cm3	7.10148E-06	
vapor pressure of constituent (Pi) @ T	atm	0.046052632	
total pressure (Pt)	atm	1	
temperature (T)	C	25	
temperature (T)	K	298	
Equilibrium Partitioning Coeff. (Keq)		4.48E-04	
calculation of emissions		**Ko = 240 * Kg * Keq; fair = 1-exp((-fo*Ko*A)/q))**	
concentration of constituent (fo)	-	9.75E-04	
mass transfer coefficient (Kg)	cm/s	1.60E-03	
Equilibrium Partitioning Coeff. (Keq)		4.48E-04	
Overall Transfer Coefficient (Ko)	cm/s	1.72E-04	
surface area of processing unit	m2	36.5	
total flowrate through processing unit	m3/s	1.86E-02	
fraction emitted to air	-	3.30E-04	
emissions	g/s	5.90E-02	
emissions	lb/hr	7.80E-03	
emissions	lb/day	1.87E-01	
emissions	lb/yr	68.36	

notes:
calculations based on region 2 of the API Separator model from EPA document: Air Emissions Models for Waste and wastewater (EPA-453/R-94-080A)
assume both tanks have emissions of Oil Separator # 2, which his the higher oil concentration